

May 18, 1937.

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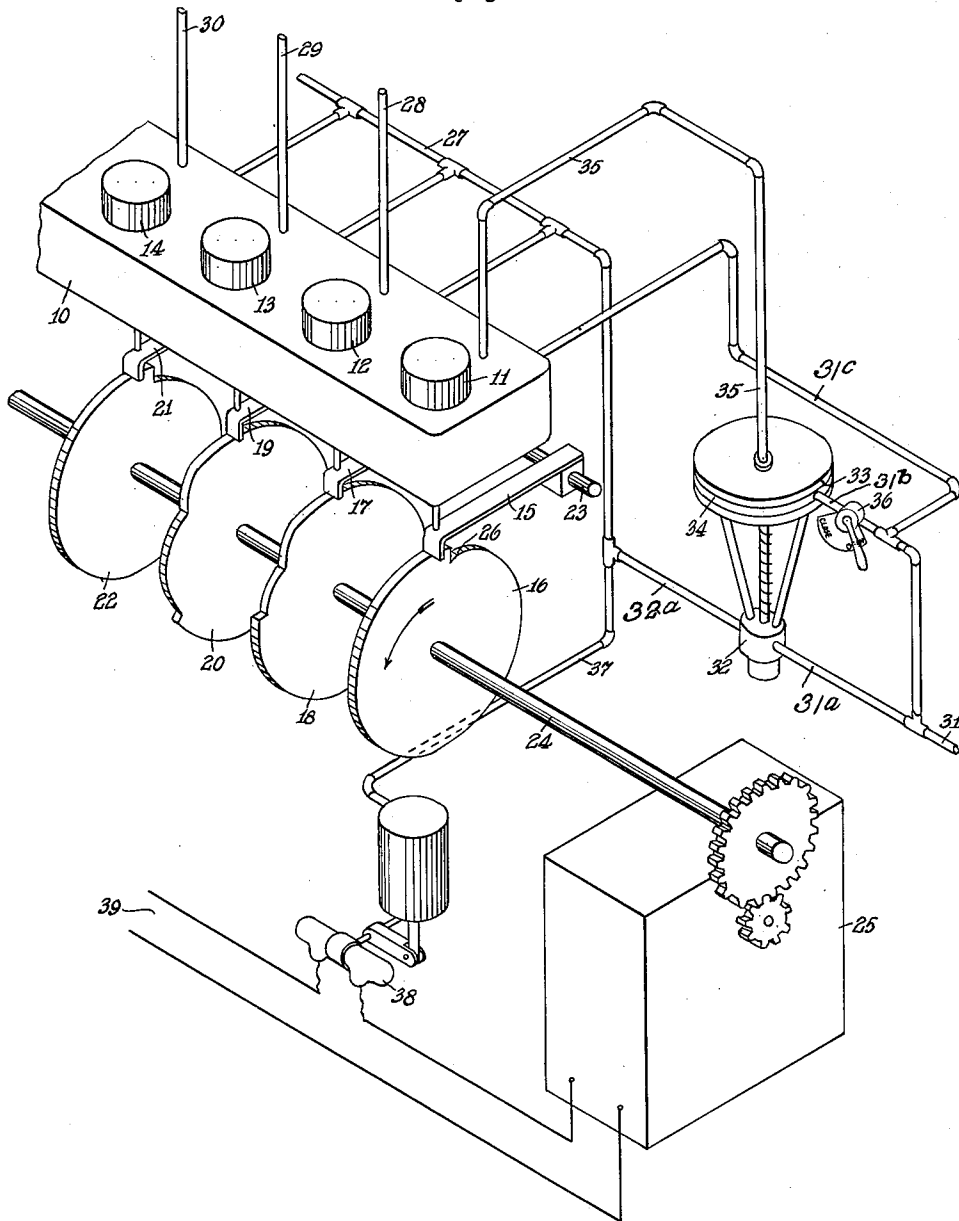
2,080,924

AUTOMATIC TERMINATOR FOR CYCLE CONTROL SYSTEMS

Filed Dec. 19, 1935

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Fig. 1.



INVENTORS
LEONARD LOGAN AND
CHARLES WEBBER
BY *Wm. R. Schuch*
ATTORNEY.

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Fig. 2.

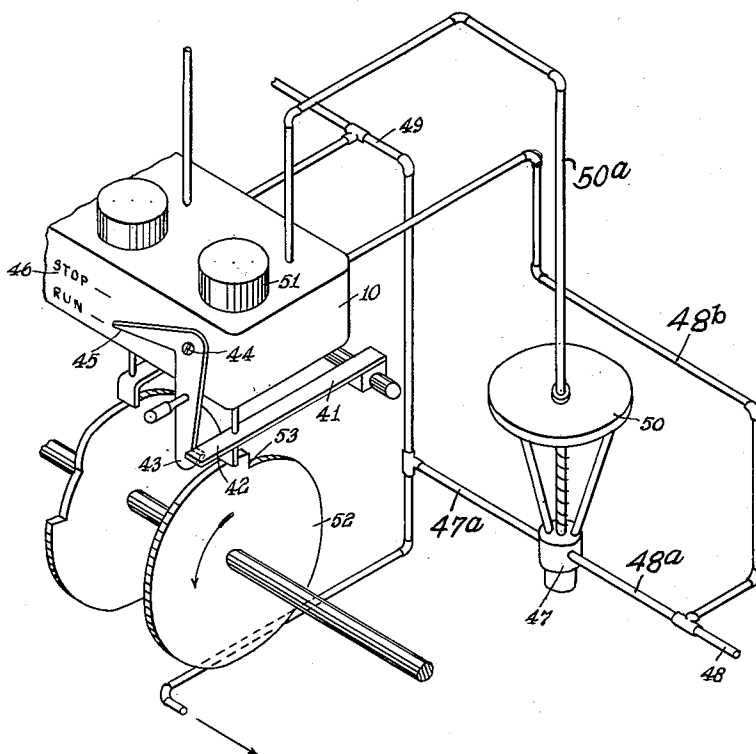
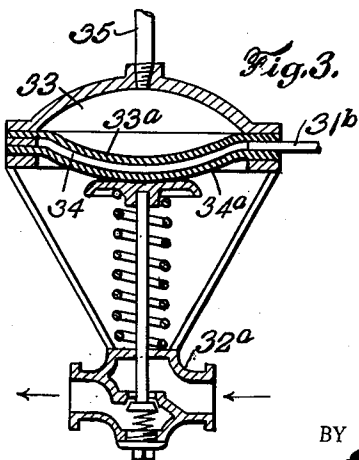


Fig. 3.



INVENTORS
LEONARD LOGAN AND
CHARLES WEBBER
BY *Frederick Schuch*
ATTORNEY.

UNITED STATES PATENT OFFICE

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AUTOMATIC TERMINATOR FOR CYCLE
CONTROL SYSTEMS

Leonard Logan, Flushing, N. Y., and Charles
Webber, Hohokus, N. J., assignors to The Bristol
Company, Waterbury, Conn., a corporation of
Connecticut

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7 Claims. (Cl. 137-145)

The invention relates to automatic process
cycle control systems, and more particularly to
a device for terminating a cycle at a definite and
predetermined time in a normally repetitive se-
quence of events.

In the automatic control of discontinuous pro-
cesses, particularly those requiring the repeated
operation of a number of valves in a definite and
predetermined sequence, it is customary to make
use of a so-called "process cycle controller".
This apparatus may take the form of a device
having a plurality of pilot valves actuated by
individual cams driven in a predetermined mutual
time relationship, the said pilot valves acting
to govern larger valves as of the air-operated
type, for example, to initiate and/or maintain
a desired condition. A discontinuous process
may be repetitive, as in the "flowing" of an oil
well, where a definite sequence of events is con-
tinuously repeated, or it may be regularly termi-
nated upon the completion of a definite occur-
rence in the cycle, as in the curing of rubber or
the polymerization of phenolic products, the cycle
in the latter case being reestablished only by the
superposition of external control. In the former
case it is customary that the motor or timing
element driving the control cams be continuously
operated, and that its operation be not sub-
ject to any of the elements under control of the
cam system. In the latter, the driving of the
motor is definitely associated with some event
in the cycle, either through a separate cam or
by being tied in with the operation of a certain
valve or like element in the mechanism.

It is an object of this invention to provide
means whereby a normally repetitive process
may be terminated by a cycle controller at a point
in the cycle corresponding to the completion of
a certain element of the cycle, the terminating
function being exercised subject to an operation
superposed on the operation of the control instru-
ment at a time prior to that at which it is de-
sired for the cycle to be terminated.

In carrying out the invention, provision is made
for a pressure-operated electric switch to inter-
rupt the circuit to a motor driving the different
cams at a uniform rotational velocity, one of the
cams controlling the said switch to terminate the
cycle at a predetermined time. In addition,
means subject to manual actuation is afforded to
render said terminating switch means inopera-
tive.

The nature of the invention, however, will best
be understood when described in connection with
the accompanying drawings, in which:

Fig. 1 is a perspective view of a portion of a
cycle control installation embodying one form
of the invention; and Fig. 2 is a perspective view
of an alternative form of an installation em-
bodying the invention.

Fig. 3 is a fragmentary vertical section of the
reverse-acting valve utilized in connection with
the embodiment illustrated in Fig. 1.

Referring to the drawings, 10 designates a
mounting block of a well-known form of pneu-
matic process-cycle controller, having mounted
thereon a plurality of pilot valves 11, 12, 13, and
14, preferably of the type set forth in U. S. Letters
Patent #1,890,494, granted September 9, 1931,
to Perry A. Borden. Each of these valves is
subject to independent actuation by respective
individual cam members, through a correspond-
ing follower element—valve 11 through a follower
15, resting on the periphery of a cam 16; valve
12 through a follower 17, from a cam 18; valve
13 through a follower 19, from a cam 20; and
valve 14 through a follower 21, from a cam 22.

The several followers are free for independent
rotation through a limited angle about a shaft
23; and the several cams are adjustably fixed
to a shaft 24 for continuous rotation as a unit
in the direction indicated by the arrow, being
driven at a uniform angular velocity by a con-
stant speed electric motor 25.

The cam 16 has upon its periphery a single
indentation 26, occupying only a small part of
the circumference, so that the follower 15 is nor-
mally held to its highest position as the cycle
proceeds, maintaining the valve 11 in its open
position. The remaining cams have their con-
tours formed in a manner that, as their respec-
tive followers rise and fall with changes in cam
radius, the corresponding pilot valves will be actu-
ated in a predetermined sequence and in a man-
ner to effect the various events required in the
carrying out of the process cycle.

The pilot valves 12, 13, and 14 receive a control
fluid such as air from a common manifold 27,
and govern the admission or exhaust of air in
conduits 28, 29, and 30, leading to various pneu-
matically actuated devices forming elements in
the system under control. It will be understood
that the pilot valve system, cam system, etc., may
be extended (toward the left in the diagram) to
govern a large number of mutually independent
events which it is desired to carry out in a
definite sequence. The pilot valve 11 receives
control air directly from a source of supply 31
through the pipe 31a.

A reverse-acting double-diaphragm valve 32,

shown in detail in Fig. 3, controls the admission of air from the supply 31 through the pipe 31b to the manifold 27. The operating head of this valve contains two diaphragms 33a and 34a, which, with the metal top of the valve, form working spaces 33 and 34, non-communicating, but jointly actuating the valve stem in a sense that when air pressure is applied to either or both of the diaphragm spaces the valve will be maintained in an open position. This will place manifold 27 in direct communication through the connections 31a and 32a, respectively, to and from the valve 32, with the supply 31, and air will be cut off from the manifold only upon pressure being relieved in both the spaces 33 and 34.

The space 33 receives its air supply through a conduit 35 and under control from the pilot valve 11 connected to the source 31 through pipe 31c, so that when the stem of this valve is lifted, by the follower 15 resting upon the greater radius of the cam 16, the corresponding diaphragm will be actuated, tending to maintain the valve 32 in an open position. The diaphragm space 34 is supplied with air from the source 31 through a stop-cock 36 and pipe 31b, which may be manually set in an open or a closed position. With the cock open as shown, fluid under the supply pressure is admitted to the space 34, maintaining the valve 32 open without regard to whether or not there be air pressure in the space 33. With the stop-cock closed, the valve 32 will be maintained open only so long as air is admitted to the space 33 through the pilot valve 11.

A conduit 37, directly communicating with the manifold 27, supplies control air to a pressure-actuated electric switch 38, so arranged that with pressure applied a circuit is completed between the motor 25 and a source of electric supply 39, causing the motor to operate; and with pressure relieved, the circuit is opened, to bring the motor to rest.

In the normal operation of a cycle, the stop-cock 36 is set in the open position, so that the valve 32 is maintained open by air pressure in the space 34, admitting control air to the manifold 27 and to pressure switch 38, causing the motor 25 to operate. This will effect the driving of shaft 24 and the cams carried thereby, so that the various events constituting the controlled cycle will be carried out in prearranged order. When the valve 11 is opened by its cam 16, air pressure will be applied to the space 33, and as the follower 15 enters the indentation 26 of said cam the valve 11 will be closed, relieving pressure in the space 33.

With the stop-cock 36 open, however, the air in space 34 will prevent the valve 32 closing; and so long as this valve is open the cycle controller will continue to operate, repeating its cycle indefinitely.

In order to cause the cycle to be terminated at a prearranged future time corresponding to the position of the indentation 26 on cam 16, it is necessary only to turn the stop-cock 36 to its closed position, which shuts off the air supply from the space 34 of the valve 32. This valve will then become dependent solely upon air pressure in the space 33 to hold it open. So long as the pilot valve 11 is held open by the cam 16, air pressure in the space 33 will maintain valve 32 open. As the indentation 26 passes beneath the follower 15, the valve 11 will be closed, relieving air pressure in the space 33. The valve 32, thus having no air pressure in either dia-

phragm space, will close, shutting off the air supply from manifold 27 and from the pressure switch 38, and thereby causing all devices controlled through the several pilot valves to assume an inert position and the motor 25 to come to rest, thus terminating the cycle at a predetermined and definite point.

In Fig. 2 is shown an alternative arrangement, in which, by a mechanical modification of the control instrument, the need for a double-diaphragm valve is obviated. The pilot valves, cams, cam-followers and associated parts are identical with those set forth in Fig. 1. The follower 15 of Fig. 1, however, is replaced by a follower 41, similar to follower 15, but having a forward projection 42 extending slightly to the front of the mounting block 10. A latch 43, pivotally mounted, as by a screw 44, upon the block 10, is adapted to be moved into and out of engagement with the extension 42 of the follower 41.

An index 45 on the latch member provides in its relation to fixed indicia 46 carried by the block 10 an indication of the position of the latch. This index may be marked, for example, "run" when the latch is engaging the extension 42 to support the follower independently of the cam 16, and "stop" when the latch is in a position of disengagement with the follower. The valve 32 of Fig. 1 is replaced by a single-diaphragm reverse-acting valve 47 connected in the line between the source 48 and the manifold 49, as through pipes 48a and 47a, respectively, to and from the valve, said valve having its single diaphragm space 50 supplied with air through the pilot valve 51 and connection 50a, the control fluid being supplied through a pipe connection 48b from the source 48.

Under conditions of continuous operation, the latch 43 is set in the "run" position, the follower 41 thus being suspended independently of cam 16, and the pilot valve is held open keeping air pressure on the diaphragm of valve 47 and maintaining in the manifold 49 and on the pressure switch (not shown) the air pressure necessary to continue the cycle. In order to cause the cycle to be automatically terminated at a predetermined future time, the latch 43 is set to the "stop" position, when the follower 41 is dependent solely on the cam 52 for support, so that as the indentation 53 passes beneath the follower 42 the latter will drop to the smaller radius of the cam, closing the pilot valve 51. This relieves pressure in the diaphragm valve 47, which assumes a closed position, thus terminating the cycle as hereinbefore set forth in connection with the description of the embodiment shown in Fig. 1 of the drawings.

We claim:

1. In a repetitive process cycle controller system including a plurality of pilot valves adapted to govern the supply of fluid to cycle-operating devices: the combination with a plurality of cams adapted to actuate said valves, and motor means to drive said cams at a uniform velocity; of means subject to actuation by one of said cams adapted to terminate said cycle at a predetermined time, and means subject to manual actuation during and prior to completion of said cycle to render said terminating means inoperative.

2. In a repetitive process cycle controller system including a plurality of pilot valves adapted to govern the supply of fluid to cycle operating devices: the combination with a plurality of cams adapted to actuate said valves, motor means to

drive said cams at a uniform velocity, a fluid-pressure-operated switch included in the circuit of said motor, and a source of fluid supply for said pilot valves and fluid-pressure-operated switch; of means subject to one of said cams for interrupting said source of fluid supply at a predetermined time, and means subject to manual actuation to render said interrupting means inoperative.

3. In a repetitive process cycle controller system including a plurality of pilot valves adapted to govern the supply of fluid to cycle operating devices: the combination with a plurality of cams adapted to actuate said valves, motor means to drive said cams at a uniform velocity, a fluid-pressure-operated switch included in the circuit of said motor, a main source of fluid supply for one of said pilot valves, a conduit for supplying the fluid to another of said pilot valves and the pressure-operated switch; of valve means adapted to provide communication between said main source of fluid supply and said conduit, and subject to control by said one pilot valve, means controlled by one of said cams to actuate said one pilot valve in a sense to close said valve means, and movable means for rendering said pilot-valve-actuated valve means inoperative.

4. In a repetitive process cycle controller system including a plurality of pilot valves adapted to govern the supply of fluid to cycle operating devices: the combination with a plurality of cams adapted to actuate said valves, motor means to drive said cams at a uniform velocity, a fluid-pressure-operated switch included in the circuit of said motor, a main source of fluid supply for one of said pilot valves, a conduit for supplying the fluid to another of said pilot valves and the pressure-operated switch; of valve means adapted to provide communication between said main source of fluid supply and said conduit, and subject to control by said one pilot valve, means controlled by one of said cams to actuate said one pilot valve in a sense to close said valve means, movable means for rendering said pilot-valve-actuated valve means inoperative, and means to provide an indication of the position of said movable means.

5. In a repetitive process cycle controller system including a plurality of pilot valves adapted to govern the supply of an expansible fluid to cycle-operating devices: the combination with a plurality of cam members operatively engaging the respective pilot valves to actuate the same in a definite and predetermined sequence, and an electric motor to drive said cams at a uniform velocity, a fluid-pressure-operated switch in circuit with said motor, a main source of expansible

fluid supply for one of said pilot valves, and a conduit for supplying the fluid to another of said pilot valves and the fluid-pressure-operated switch and connected to the main source of expansible fluid supply; of valve means interposed between said conduit and the said source of supply and embodying two pressure-responsive members controlling the opening and closing of said valve means, one of said responsive members being actuated from said main source of supply through the one of said pilot valves, and manually actuated means for actuating the other of said responsive members in controlling the supply of fluid thereto from said main source of fluid supply.

6. In a repetitive process cycle controller system including a plurality of pilot valves adapted to govern the supply of an expansible fluid to cycle-operating devices: the combination with a plurality of cam members operatively engaging the respective pilot valves to actuate the same in a definite and predetermined sequence, and an electric motor to drive said cams at a uniform velocity, a fluid-pressure-operated switch in circuit with said motor, a main source of expansible fluid supply for one of said pilot valves, and a conduit for supplying the fluid to another of said pilot valves and the fluid-pressure-operated switch and connected to the main source of expansible fluid supply; of valve means interposed between said conduit and the said source of fluid supply and subject to operation through the one of said pilot valves, and means maintaining said one pilot valve in an open position independently of the cam means by which it is normally actuated.

7. In a repetitive process cycle controller system including a plurality of pilot valves adapted to govern the supply of an expansible fluid to cycle-operating devices: the combination with a plurality of cam members operatively engaging the respective pilot valves to actuate the same in a definite and predetermined sequence, and an electric motor to drive said cams at a uniform velocity, a fluid-pressure-operated switch in circuit with said motor, a main source of expansible fluid supply for one of said pilot valves, and a conduit for supplying the fluid to another of said pilot valves and the fluid-pressure-operated switch and connected to the main source of expansible fluid supply; of valve means interposed between said conduit and the said source of fluid supply and subject to operation through the one of said pilot valves, and manual means for disengaging said one pilot valve from its cam means.

LEONARD LOGAN.
CHARLES WEBBER.